What is claimed is:

1. A magnetic resonance imaging system comprising:

(a) a housing providing a medical diagnostic chamber for a subject therewithin lying along an axis;

(b) a transmit/receive inductor system about said axis in proximity with said housing;

(c) a gradient inductor system operatively associated with said transmit/receive inductor system;

(d) a static magnetic field inductor system operatively associated with said transmit/receive inductor system;

(e) said transmit/receive inductor system constituting a coil having an outer surface about said axis and including a series of electrical transmission line elements paraxially distributed with respect to said axis about said subject, each of said transmission line elements including an outer conductor and an inner conductor, said inner conductor being spaced from said outer conductor in a direction perpendicular to said outer surface;

(f) said coil initially transmitting to said subject fields of radio frequency energy as a transmit signal, and responsively receiving from said subject fields of magnetic resonance energy as a receive signal;

(g) said gradient inductor system initiating perturbations in said fields and producing signals derived responsively from said perturbations;

(h) said signals corresponding to spatial indicia derived from said subject.

2. The magnetic resonance imaging system of claim 1 wherein said coil establishes concentrations of electromagnetic fields among said transmission line segments.

3. The magnetic resonance imaging system of claim 2 wherein, by adjusting the distance between said transmission line segments, the interaction of the magnetic fields of said transmission line segments with an external sample can be controlled and optimized for nuclear magnetic resonance signal generation and/or detection.

4. The magnetic resonance imaging system of claim 1 wherein said plural transmission line segments decrease the inductance of each line segment and minimize the electric fields associated therewith, whereby dielectric tissue losses is said subject are reduced.

5. The magnetic resonance imaging system of claim 1 wherein said plural transmission line segments have inherent shielding, whereby coupling between said transmission line segments is controlled.

6. The magnetic resonance imaging system of claim 1 wherein said plural line segments are combined to optimize NMR signal generation and/or reception.

7. The magnetic resonance imaging system of claim 1 wherein signals form said plural line segments are combined to decode spatial information derived from the NMR signal, thereby to increase the sensitivity and speed of data acquisition.

8. The magnetic resonance imaging system of claim 1 wherein said inductor consists of N transmission line segments arranged in a geometric pattern in which said line segments are substantially equidistant from each other.

9. The magnetic resonance imaging system of claim 1 wherein said geometric pattern is circular or elliptical.

10. The magnetic resonance imaging system of claim 1 wherein said geometric pattern is flat or curved.

11. The magnetic resonance imaging system of claim 1 wherein each of said transmission line segments includes at least two individual conductors together with additional lumped or distributed capacitive or inductive circuit components.

12. The magnetic resonance imaging system of claim 1 wherein each transmission line element couples to the others through mutual inductance and capacitive coupling.

13. The magnetic resonance imaging system of claim 1 wherein distributed impedance elements are connected between certain of said transmission line segments to alter the coupling therebetween.

14. The magnetic resonance imaging system of claim 1 wherein impedance elements are connected between said transmission line segments to establish interactions that establish frequency dependent relations between the currents and voltages present on certain of said transmission line segments.

15. The magnetic resonance imaging system of claim 1 wherein a given current distribution is obtained on said transmission line elements at a given frequency by adjustment of the geometry of said transmission line elements and circuit components connected among said transmission line elements.

16. The magnetic resonance imaging system of claim 1 wherein the fields generated by the currents in said transmission line elements are superposed to create a given magnetic field configuration for use in either or both the generation and detection of the NMR signal.

17. The magnetic resonance imaging system of claim 1 including RF power amplifiers and/or RF receivers coupled to at least one of said transmission line elements for transferring energy into said coil during the generation of said transmit signal and out of said coil during the reception of said receive signal.

18. The magnetic resonance imaging system of claim 1 including at least an RF power amplifier reactively coupled to at least one of said transmission line elements for transferring energy into said coil during the generation of said transmit signal, the impedance of said RF power amplifier and the impedance of said one of said transmission line elements being matched.

19. The magnetic resonance imaging system of claim 1 including at least an RF receiver reactively coupled to at least one of said transmission line elements for transferring energy from said coil during the reception of said receive signal, the

impedance of said RF receiver and the impedance of said one of said transmission line elements being matched.

20. The magnetic resonance imaging system of claim 1 wherein the phases of the current in a plurality of said transmission line segments are offset so as to create an elliptically polarized magnetic field for generating and/or detecting nuclear magnetic resonance signals.

21. The magnetic resonance imaging system of claim 17 including a plurality of diodes operatively connected to a plurality of said transmission line segments for tuning the coupling between said transmission line segments and said RF amplifiers and receivers.

22. The magnetic resonance imaging system of claim 1 including reactive coupling elements between one or more transmission line elements to allow the currents on each transmission line element to be relatively independent.

23. The magnetic resonance imaging system of claim 1 with individual preamplifiers connected to each transmission line element with impedance mismatches designed to allow each transmission line element to operate independently allowing the signals from each transmission line element to be combined either before or after image reconstruction for optimal image reception.

24. The magnetic resonance imaging system of claim 1 with individual preamplifier/receivers connected to each transmission line element with the independent information obtained from individual transmission line elements being used to decode spatial information regarding said subject.

25. The magnetic resonance imaging system of claim 1, with individual power amplifiers connected to each transmission line element with impedance mismatches designed to allow the current of each transmission line element to be independently controlled allowing a transmit field of desired spatial intensity and phase to be generated.

26. A magnetic resonance imaging system comprising:

(a) a housing providing a medical diagnostic chamber with a static homogenous magnetic field for a subject therewithin lying along an axis;

(b) a plurality of transmit/receive inductor systems about said axis in proximity with said housing;

(c) a gradient inductor system operatively associated with said transmit/receive inductor systems;

(d) a static magnetic field inductor system operatively associated with said transmit/receive inductor systems;

(e) at least one of said transmit/receive inductor systems constituting a coil having an outer surface about said axis and including a series of electrical transmission line elements paraxially distributed with respect to said axis about said subject, each of said transmission line elements including an outer conductor and an inner conductor, said inner conductor being spaced from said outer conductor in a direction perpendicular to said outer surface;

(f) each said coil selectively transmitting to said subject fields of radio frequency energy, and selectively receiving from said subject fields of magnetic resonance energy;

(g) said gradient inductor system initiating perturbations in said fields and producing signals derived responsively from said perturbations;

(h) said signals corresponding to spatial indicia derived from said subject.

27. The magnetic resonance imaging system of claim 26, wherein one of said coils is a conventional loop inductor.

28. The magnetic resonance imaging system of claim 26, wherein one of said coils is a conventional loop inductor which is detuned during transmit function, said transmit function being performed by a transmission line coil which is detuned during receive.

29. The magnetic resonance imaging system of claim 26, wherein one of said coils is a phased array of conventional loop inductors.

30. The magnetic resonance imaging system of claim 26, wherein one of said coils is a phased array of conventional loop inductors which are detuned during transmit

function, said transmit function being performed by a transmission line coil which is detuned during receive function.

31. The magnetic resonance imaging system of claim 26, wherein one of said coils is an array of said transmission line elements each operated independently with individual preamplifiers/receivers.

32. The magnetic resonance imaging system of claim 26, wherein one of said coils is an array of said transmission line elements each operated independently with individual preamplifiers/receivers, said array being detuned during system transmit function.

33. The magnetic resonance imaging system of claim 26, wherein said system includes at least two coils, one of said coils being a transmit coil and the other of said coils being a receive coil.

34. A magnetic resonance imaging system comprising:

(a) a housing providing a medical diagnostic chamber for a subject therewithin lying along an axis;

(b) a transmit inductor system about said axis in proximity with said housing;

(c) a gradient inductor system operatively associated with said transmit inductor system;

(d) a static magnetic field inductor system operatively associated with said transmit inductor system;

(e) said receive inductor system constituting a coil having an outer surface about said axis and including a series of electrical transmission fine elements paraxially distributed with respect to said axis about said subject, each of said transmission line elements including an outer conductor and an inner conductor, said inner conductor being spaced from said outer conductor in a direction perpendicular to said outer surface, said coil including a means for detuning said coil to prevent disturbance of the transmit fields generated by a separate transmit inductor system;

(f) said coil initially transmitting to said subject fields of radio frequency energy as a transmit signal;

(g) said gradient inductor system initiating perturbations in said fields.

35. The magnetic resonance imaging system of claim 34 wherein said coil establishes concentrations of transmit electromagnetic fields among said transmission line elements.

36. The magnetic resonance imaging system of claim 34 wherein, by adjusting the distance between said transmission line elements, the interaction of the magnetic fields of said transmission line elements with an external sample can be controlled and optimized for nuclear magnetic resonance signal generation excitation.

37. The magnetic resonance imaging system of claim 34 wherein said series of transmission line elements decrease the inductance of each line element and minimize the electric fields associated therewith.

38. The magnetic resonance imaging system of claim 34 wherein said series of transmission line elements have inherent shielding.

39. The magnetic resonance imaging system of claim 34 wherein said transmit inductor system consists of N transmission line elements arranged in a geometric pattern in which each of said transmission line elements is substantially equidistant from each adjacent transmission line element.

40. The magnetic resonance imaging system of claim 39 wherein said geometric pattern is circular or elliptical.

41. The magnetic resonance imaging system of claim 39 wherein said geometric pattern is flat or curved.

42. The magnetic resonance imaging system of claim 34 wherein said outer and inner conductors include additional lumped or distributed capacitive or inductive circuit components.

43. The magnetic resonance imaging system of claim 34 wherein each of said transmission line elements couples to the other of said transmission line elements through mutual inductance and capacitive coupling.

44. The magnetic resonance imaging system of claim 34 wherein distributed impedance elements are connected between certain of said transmission line elements to alter the coupling therebetween.

45. The magnetic resonance imaging system of claim 34 wherein impedance elements are connected between said transmission line elements to establish interactions that establish frequency dependent relations between the currents and voltages present on certain of said transmission line elements.

46. The magnetic resonance imaging system of claim 34 wherein a given current distribution is obtained on said transmission line elements at a given frequency by adjustment of the geometry of said transmission line elements and circuit components connected among said transmission line elements.

47. The magnetic resonance imaging system of claim 34 wherein the fields generated by the currents in said transmission line elements are superposed to create a given magnetic field configuration for use the generation of the NMR signal.

48. The magnetic resonance imaging system of claim 34 including RF power amplifiers coupled to at least one of said transmission line elements for transferring energy into said coil during the generation of said transmit signal.

49. The magnetic resonance imaging system of claim 34 including at least an RF power amplifier reactively coupled to at least one of said transmission line elements for transferring energy into said coil during the generation of said transmit signal, the impedance of said RF power amplifier and the impedance of said one of said transmission line elements being matched.

50. The magnetic resonance imaging system of claim 34 wherein the phases of the current in a plurality of said transmission line elements are offset so as to create an elliptically polarized magnetic field for generating and/or detecting nuclear magnetic resonance signals.

51. The magnetic resonance imaging system of claim 34 including a plurality of diodes operatively connected to a plurality of said transmission line elements for tuning the coupling between said transmission line elements.

52. The magnetic resonance imaging system of claim 34 including coupling components between one or more of said transmission line elements to allow the currents on each of said transmission line elements to be independently controlled with separate power amplifiers connected to one or more of said transmission line elements allowing a transmit field of desired spatial intensity and phase to be generated.

53. The magnetic resonance imaging system of claim 34 with individual power amplifiers connected to each transmission line element with impedance mismatches designed to allow the current of each transmission line element to be independently controlled allowing a transmit field of desired spatial intensity and phase to be generated.

54. A magnetic resonance imaging system comprising:

(a) a housing providing a medical diagnostic chamber for a subject therewithin lying along an axis;

(b) a receive inductor system about said axis in proximity with said housing;

(c) a gradient inductor system operatively associated with said receive inductor system;

(d) a field inductor system operatively associated with said receive inductor system;

(e) said receive inductor system constituting a coil having an outer surface about said axis and including a series of electrical transmission line elements paraxially distributed with respect to said axis about said subject, each of said transmission line elements including an outer conductor and an inner conductor, said inner conductor being spaced from said outer conductor in a direction perpendicular to said outer surface, said coil including a means for detuning said coil to prevent disturbance of the transmit fields generated by a separate transmit inductor system;

(f) said coil receiving from said subject fields of magnetic resonance energy;

(g) said gradient inductor system initiating perturbations in said fields and producing signals derived responsively from said perturbations;

(h) said signals corresponding to spatial indicia derived from said subject.

55. The magnetic resonance imaging system of claim 54 wherein, by adjusting the distance between said transmission line elements, the interaction of the magnetic fields of said transmission line elements with an external sample can be controlled and optimized for nuclear magnetic resonance signal detection.

56. The magnetic resonance imaging system of claim 54 wherein said series of transmission line elements decrease the inductance of each transmission line element and minimize the electric fields associated therewith.

57. The magnetic resonance imaging system of claim 54 wherein said series of transmission line elements have inherent shielding.

58. The magnetic resonance imaging system of claim 50 wherein said series of transmission line elements are combined to optimize NMR signal reception.

59. The magnetic resonance imaging system of claim 50 wherein signals from said series of transmission line elements are combined to decode spatial information derived from the NMR signal.

60. The magnetic resonance imaging system of claim 50 wherein said receive inductor system consists of N transmission line elements arranged in a geometric pattern in which each of said transmission line elements is substantially equidistant from each adjacent transmission line element.

61. The magnetic resonance imaging system of claim 60 wherein said geometric pattern is circular or elliptical.

62. The magnetic resonance imaging system of claim 60 wherein said geometric pattern is flat or curved.

63. The magnetic resonance imaging system of claim 59 wherein said outer and inner conductors include additional lumped or distributed capacitive or inductive circuit components.

64. The magnetic resonance imaging system of claim 59 wherein each of said transmission line elements couples to the other of said transmission line elements through mutual inductance and capacitive coupling.

65. The magnetic resonance imaging system of claim 59 wherein distributed impedance elements are connected between certain of said transmission line elements alter the coupling therebetween.

66. The magnetic resonance imaging system of claim 59 wherein impedance elements are connected between said transmission line elements to establish interactions that establish frequency dependent relations between the currents and voltages present on certain of said transmission line elements.

67. The magnetic resonance imaging system of claim 59 wherein a=given current distribution is obtained on said transmission line elements at a given frequency by adjustment of the geometry of said transmission line elements and circuit components connected among said transmission line elements.

68. The magnetic resonance imaging system of claim 59 wherein the fields generated by the currents in said transmission line elements are superposed to create a given magnetic field configuration for use in the detection of the NMR signal.

69. The magnetic resonance imaging system of claim 59 including RF receivers coupled to at least one of said transmission line elements for transferring energy out of said coil during receive.

70. The magnetic resonance imaging system of claim 59 wherein the phases of the current in a plurality of said transmission line elements are offset so as to create an elliptically polarized magnetic field for detecting nuclear magnetic resonance signals.

71. The magnetic resonance imaging system of claim 69 including a plurality of diodes operatively connected to a plurality of said transmission line elements for tuning the coupling between said transmission line elements and said RF receivers.

72. The magnetic resonance imaging system of claim 59 including coupling elements between one or more of said transmission line elements in order to make the currents on each of said transmission line elements relatively independent allowing the signals from two or more of said transmission line elements to be optimally combined before or after image reconstruction.

73. The magnetic resonance imaging system of claim 59 with individual preamplifiers connected to each of said transmission line elements with impedance mismatches designed to allow each of said transmission line elements to operate independently allowing the signals from two or more of said transmission line element to be optimally combined either before or after image reconstruction.

74. The magnetic resonance imaging system of claim 59 with individual preamplifier/receivers connected to each transmission line element with the independent information obtained from individual transmission line elements being used to decode spatial information regarding said subject.